Final Deliverable
Project Activities in the Czech Republic
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Evaluation of Energy Efficiency Projects

Prepared by

SEVEn

Prague, Czech Republic

Under Subcontract to

Electrotek Concepts, Inc.
Arlington, Virginia USA

Prepared for

United States Agency for International Development
Czech Republic and Washington, DC
Regional Energy Efficiency Project (180-0030)
Contract No DHR-C-00-95-00064-00

03 September, 1998

The Energy Efficiency Center
Středisko pro efektivní využívání energie

SEVEn

Publication No 98/018/A

EVALUATION OF ENERGY EFFICIENCY PROJECTS CARRIED OUT AS PART OF A US AID PROGRAM

Pavel Kámík

The goal of the program evaluated in this report was to locate and assist in carrying out energy efficiency projects in hospitals and schools that would serve as models in the future In the Ivančice Hospital the source of the heat supply was replaced, in the Litoměřice Hospital an energy use control and management system was introduced, and in the Frýdlant v Cechach Hospital a cogeneration unit was installed In the Mimoň Ralsko School regulation was upgraded with Individual Room Control
The program was launched in cooperation with US specialists in 1996 and completed in 1998

July 1998

SEVEn
Slezská 7
120 56 Prague 2
Czech Republic
☎+420-2-2424 7552 Fax +420-2-2424 7597

INTRODUCTION

The creation of a new national energy policy for the Czech Republic is linked to energy efficiency measures that are gradually being put into practice In support of this, assistance was obtained through a US AID program the objective of which was not merely to solve a particular problem in a single locality Rather, its goal was to see a project planning and management methodology adopted, cooperation fostered among the international team of Czech and US experts from Tysak Engineering and Electrotek Concepts, and experiences shared and know-how transferred so that in the future similar projects could be carried out by SEVEn on its own or routinely with international partners SEVEn worked together on these projects with US AID consultants who provided expert advice, offered design options, and who, with our specialists, planned energy efficiency projects to be carried out

PACE OF ACTIVITIES

The first specific discussions on the initiative began in the fall of 1996 With the signing of contract DHR-C-00-95-00064-00 in October 1996 between ELECTROTEK CONCEPTS, Inc and SEVEn of Prague, cooperation was commenced on the technical and financial planning of energy efficiency projects in hospitals Czech experts together with American consultants conducted energy audits in the following hospitals

Ivančice
Litoměřice
Frydlant
Ostrava Fifejdy
and in the Mimoň Elementary School

The aim of the audits was to assess the efficiency and reliability of the energy supply to the facilities and their linkage to the external distribution network Audits demonstrated that in all the monitored hospitals and the school there were realistic opportunities to reduce energy consumption For selected facilities technical work was proposed and negotiations begun on funding these projects Within a very short time projects were planned for the following facilities the hospitals in Ivančice, Litoměřice, Frydlant, and the elementary school in Mimoň

The amount of time needed to plan and carry out the projects differed and depended on the difficulty of the changes and modifications to the energy management of the facilities In some cases project planning required more time because it was necessary to obtain more detailed data on energy consumption and its sources This consequently made it possible to optimize the technical designs and plan major modifications to the technology In the final result, it proved to be good training in how to make use of the future energy management system

The timeframe for carrying out the projects varied and depended on the difficulty of the changes and modifications to the energy system of the facilities

OVERVIEW OF PROJECTS

The energy efficiency project in the Ivančice Hospital involved all aspects of the facility's heating, including the hot domestic water preparation and steam production for technological

purposes The hospital was originally connected to the district heating steam network that supplied steam to the central exchanger station and individual technologies At the present time the hospital complex is being supplied with heat in the form of hot water that serves both as heating water and for hot domestic water preparation The technological steam is produced in gas steam generators Construction was begun in September 1997 and completed in February 1998

The energy efficiency project in the Litoměřice Hospital involved all aspects of the facility's energy management system Its operation is now based on measuring the energy where it enters the hospital complex, its distribution, as well as at the nodal points including supplemental variables Data on all measured variables are fed to the energy dispatching and at the same time to the monitor in the hospital's technical control room The system takes regular read-outs from the individual sensors, archives them and permits further work with the archived data Construction was begun in August 1997 and was completed in January 1998 By upgrading the measurement technology of the hospital complex it was possible to launch an energy savings program and introduce genuine control and management of all kinds of energy consumption The archived data is used to evaluate the activity of the individual groups of users and appliances The system allows investment in the facility's energy management to be planned more skillfully

In the Frydlant Hospital the replacement of the back-up source of electricity with a cogeneration unit allowed the electricity and heat supply to be changed The cogeneration unit is comprised of a JENBACHER JSM 106 GS-N piston motor with an electrical output of 70 kW and a heat output of 115 kW The power and heat produced in the cogeneration unit are fed to the hospital's power and heat distribution networks Surplus power and heat are supplied to the city's distribution networks Work on the project was begun in August 1997 and trial operation was commenced in January 1998

The project in the Mimoň Ralsko Elementary School was carried out in two stages In the first the school atrium was insulated The single-paned glass in the atrium was taken down, a metre-high wall was erected, and double-paned plastic windows were mounted The atrium interior was lined with ceramic facing tiles In the second stage the Individual Room Control system was installed The heaters were equipped with a total of 208 HEIMEIER radiator valves with regulation heads In the entire school complex, 126 area thermometers were mounted Regulation heads and area thermometers were connected to 14 TVS 103 control units These units were connected to the control computer

Economic Evaluation

In an economic evaluation it is necessary to work with data for a longer period than four to six months In order to present the results of the projects clearly, savings for the different operational periods were recalculated to produce figures for the entire year Data for these periods show not only savings in energy but also in maintenance and staffing costs The measures in the hospitals and the school are a guarantee of further savings These will arise from the optimized operation of new and old pieces of equipment and improved organization of the work of the staff The following table presents data from the documents submitted by the individual hospitals and the school

Table 1 – Economic Evaluation of the Projects

Project Name	Period of Operation (Months)	Energy Savings (GJ/yr)	Energy Cost Savings (CZK/yr)	Maintenance Cost Savings (CZK/yr)	Salary Cost Savings (CZK/yr)	Total Savings (CZK/1998)	Investment (CZK)	Simple Payback Period (years)
Ivancice Hospital	4	6 775	2 357 208	20 000	480 000	2 857 208	10 150 000	3 6
Litomerice Hospital	6	4 892	1 802 318	30 000	50 000	1 882 318	1 200 000	0 6
Frydlant Hospital	5	0	260 751	220 000	0	480 751	4 600 000	9 6
Mimon School	7	1 228	379 634	0	0	379 634	1 550 555	4 1

While evaluating the individual projects it emerged that the energy management system has a very fast payback period The hospitals and school also realized that without regular checks of their energy systems and analysis of archived data neither operation nor the contracts with energy suppliers may be optimized

Investment in mechanical technological units and regulation systems has a longer payback period, but produces greater savings In the case of the Frydlant Hospital it emerged that it will be necessary to optimize the project further technically and organizationally Hospital management is aware of this, but due to a lack of experience in, for instance, maintaining the quarter-hour maximum or operating the cogeneration unit, it is only conducting analysis of data and has not yet attempted to change the power supply contract The reason for this is concern that an ill-considered change in the contract will result in higher costs in the future

SUMMARY

In the final evaluation of the projects the management of the hospitals and school placed great emphasis on good cooperation with the experts of both countries involved What was especially appreciated was the comprehensive project approach The financial contribution that in the initial project phase was considered to be of primary importance now appears to have been secondary Introduction of an energy management system is considered to be a new direction that has made energy management work more effective

The energy savings calculated at 12,895 GJ/year and the projected financial savings of 5 6 million CZK/year are a good way to gauge the value of invested resources Total investment came to 16 7 mil CZK The simple payback period has been calculated at 3 1 years US AID's contribution amounted to a 14 3% share (2 5 mil CZK) of total investment

In September 1997 SEVEn organized two one-day seminars in which hospital representatives were acquainted with how to go about energy efficiency projects Presentations were made by Czech experts and by Andrew Popelka consultant with the US firm TYSAK Engineering Co

The seminars raised interest not only in the technical side of projects but also in the funding of them The objective of this program was to optimize energy consumption and costs while maintaining the security and reliability of energy supplies with a minimal adverse impact on

the environment This process has been started in hospitals not only by means of theoretical training, but also through the first practical steps towards the implementation of efficiency measures

Photo 1 – Seminar on the topic "Energy Efficiency in Hospitals of the Czech Republic" held September 4 1997 in Ivančice A Popelka of Tysak Engineering Co presenting

CONCLUSIONS

The outcomes of the US AID program demonstrated that

- energy savings are able to pay for themselves in virtually all hospitals where it is realistic to change steam heating systems to hot water and equip technological appliances with sources of steam,
- large savings are possible in schools heated by district heating with simple regulation of heating water
- information dissemination can raise awareness of energy efficiency potential, as evidenced by the roughly 50% increase in the number of applications for such projects from health care facilities to the Czech Energy Agency in 1998 compared to 1997

In the course of evaluating the projects it was confirmed that

- the deciding factor in the success of an energy efficiency project is not only the technology but above all the interest of the management and its ability to make good use of the technology
- for efficiency projects to spread further it is necessary to persuade hospital management with evidence of the energy and financial savings, lower staffing requirements, higher reliability of the energy system, simplified maintenance, etc
- the energy equipment staff need to be motivated to continually optimize operation of the energy system and at the same time provide timely and quality maintenance

- to speed up the process of introducing efficiency measures it was necessary to support the funding of capital expenditures on the energy system with time-limited grants

The general outcomes of the program served as the basis for

- the drafting of an energy efficiency program being prepared by the Ministry of the Environment in cooperation with the World Bank
- discussions with the Ministry of Health in which a uniform method for energy audits in hospitals was recommended SEVEn will negotiate further concerning this method
- planning of the Energy Efficiency Business Week '98 Conference and Exhibition, which will include a session "The Present and Future of EPC in the Czech Republic" presenting and discussing the energy problems of hospitals, their reconstruction and funding, including subsequent operation
- the decision of the Czech government to support energy efficiency by means of EPC in both fully and partially state-owned facilities A directive of the Ministry of Finance concerning this method of funding will be issued in November of this year

Descriptions of the individual projects are presented in Appendices 1 to 4

Appendix 1

Ivančice Hospital and Polyclinic

Address Široka 16, 664 95 Ivančice, Czech Republic

The Ivančice Hospital is a public regional facility At present it has 255 beds, 6 basic departments, and includes a long-term care treatment center in the village of Zastavka u Brna Eight thousand patients annually are hospitalized in the facility In April 1998 the Ministry of Health gave approval for the facility to operate for another five years

The hospital is supplied with electricity by JME (South Moravia Power), with gas by JMP (South Moravia Gas), with heat in the form of steam by the firm Spalovna prumyslovych odpadu (Industrial Waste Incineration), and as heating water by Teplo Ivančice (Ivančice Heat) Drinking water is supplied by the company VaS of Brno For an interim period both suppliers provided the hospital with heat As of July 1, 1998, however, the hospital no longer draws steam from the network

The energy efficiency project in the Ivančice hospital involved all aspects of the facility's heating, including preparation of hot domestic water and the steam production for technological purposes The hospital was originally attached to a steam network that supplied steam to a central exchanger station and to individual technological units (the kitchen, 10 sterilizers and two distillation units) At present the hospital complex is supplied with heat in the form of hot water that is used for both heating and preparation of hot domestic water Technological steam is produced in a gas steam generator

Work Carried Out under the Energy Efficiency Project

- natural gas line
- heat line
- construction of a hot water network in the hospital complex with pre-insulated piping
- building eight exchanger stations
- building a source of technological steam

Sources of Project Funding

The cost of the entire project came to 10,15 mil CZK The funding scheme broke down as follows

- 5,15mil CZK grant from the Brno – venkov (Rural Brno) county government
- 3 5 mil CZK contribution from the Czech Energy Agency
- 0 7 mil CZK contribution from US AID
- 0 8 mil CZK of the hospital's own resources

Description of the Work

A total of 150 metres of natural gas lines were laid from Oslavanska Street to the hospital's physical plant building and to the surgical building, where a steam generator is located

A total of 450 metres of heat distribution lines were likewise laid from Oslavanska Street to the old boiler house from where they were fed to eight exchanger stations in which hot domestic water is prepared for individual buildings

Within the hospital complex, eight pressure-dependent exchanger stations were constructed They were installed in places with optimal conditions for distribution in the individual buildings
In the basement of the surgery building a Fairman F 500 gas-operated steam generator was installed with a steam output of 500 kg/h It is connected with cation-treated water from the city's system

As part of this project a dispatching system to manage the heating network was established It is assumed that in the future all power and water meters will be connected to this system

Schedule of Construction Work

Construction was begun in September 1997 In the course of construction there was a delay in connecting the hospital complex to the hot water network Hot water conduits into the hospital complex were constructed by Teplo Ivančice a s This company also laid the heat distribution lines in that part of the city and the target completion date for the work was pushed back several times The conduit was connected to the old boiler house on January 31, 1998 This affected the final savings for the 1997/98 heating season For that reason the savings can only be calculated from March 1998

Project Evaluation

The energy savings have been calculated from four months of data and are presented in Table 2

Table 2 – Assessment of Energy and Water Savings in the Ivančice Hospital

Year	1 997			1 998				Savings		
Month	Steam consumption (GJ/mo)	Condensate losses (m^3/mo)	Costs (CZK/mo)	Heat consumption (GJ/mo)	Gas consumption (m^3/mo)	Water consumption (m3/mo)	Costs (CZK/mo)	Heat savings (GJ/ mo)	Water savings (m^3/mo)	Cost savings (CZK/mo
March	2 204	618	620 834	1 658	4,050	132	425 441	409	486	195 39
April	2 704	758	761,672	1 133	2,795	99	295,838	1476	659	465 83
May	909 000	254	256 034	500	3 446	121	186 631	292	133	69 38
June	545 000	152	153 502	235	6,703	160	98,375	82	8	55 12
Total	6 362	1 782	1 792,042	3 526	16 994	512	1 006 305	2 258	1 270	785 73

Conclusion

From the technical viewpoint the project meets all the requirements of a modern hot water network and at the same time allows the source of technological steam to be used optimally In addition to the installed technology a change has occured in the approach of the hospital administration to energy The main power engineer regularly prepares materials for the hospital administration on energy and water consumption, repairs to energy equipment are carried out without delay, and analysis is conducted on the basis of the archived data to determine further ways to reduce consumption

Photo 2 – The entrance building of the Ivancice Hospital

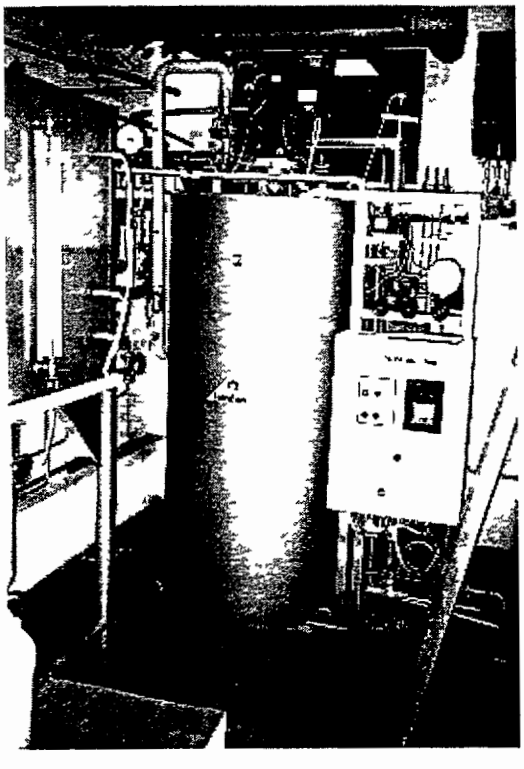


Photo 3 – The steam generator installed in the Ivančice Hospital

Appendix 2

Litoměřice City Hospital

Address Žitenicka 22, 412 01 Litoměřice Czech Republic

The Litoměřice Hospital is a regional facility At present it has 576 beds and 7 basic departments A total of 15,600 patients annually are hospitalized in the facility The hospital is partially funded by the city

The hospital is supplied with electricity by SČE (North Bohemia Power), with gas by SČP (North Bohemia Gas), and with heat by the Litoměřice Division of Severočeske telplarnv (North Bohemia District Heating) Drinking water is supplied by the company SVaK of Litoměřice

The energy efficiency project in the Litoměřice hospital involved all aspects of the facility's energy management system Its operation is now based on measuring the energy where it enters the hospital complex, its distribution, as well as at the nodal points including supplemental variables Data on all measured variables are fed to the energy dispatching and at the same time to the monitor in the hospital's technical control room The system takes regular read-outs from the individual sensors, archives them and permits further work with the archived data

Work Carried Out under the Energy Efficiency Project

- Installation of sensors and meters
  - measuring of main intakes – electricity, gas
  - measuring of outside temperature
  - measuring of two exchanger stations — 2 heat meters
    4 hot domestic water thermometers
    2 flow meters for measuring make-up water
  - measuring of electrical output and consumption in the kitchen and the refrigeration engine room
  - measuring of heat consumption in three buildings – gynecology, surgery and internal medicine
- Construction of an energy dispatching center

Sources of Project Funding

The cost of the entire project came to 1 2 mil CZK The funding scheme broke down as follows

- 0 6 mil CZK of the hospital's own resources
- 0 6 mil CZK contribution from US AID

Description of the Work

Work on the project was begun by installing the individual groups of meters in the piping network and connecting them to the newly built energy dispatching center The dispatching was linked to a METASYS system from the firm Johnson Controls used for measuring and regulating large ventilation units The dispatching center is now connected to the ventilation control room and allows the hospital's energy use to be optimized

Schedule of Construction Work

In the course of construction a delay occurred in the installation of the devices in the piping network That affected the final savings for the 1997/98 heating season The savings can therefore be calculated only from January 1998

Project Evaluation

The Litoměřice Hospital is a modern facility constructed from 1979 – 1989 and from 1993 – 1996 Within the complex the measuring technology has been upgraded which for the most part did not allow the power engineers to conduct analyses of energy consumption previously From the archived data it was found out that in Building 02 there were disproportionately high heat consumption Modification of the ventilation and heating software led to a reduction in heating costs in January 1998 Additionally, emphasis has been put on the electricity demand in particular where it exceeds the technical maximum By consistently controlling the demand, during the first four months of the year savings on electricity costs were achieved of 115,629 CZK The organizational measures implemented are not only helping to maintain consumption discipline, but also to prepare further projects to be carried out These are to optimize

- the electricity load curve
- heat regulation in Buildings 310 and 209
- steam production and consumption in the hospital complex

Table 3 - Heat and electricity savings over four months in the Litoměřice Hospital

	Heat Consumption (GJ/mo) 1997	Heat Consumption (GJ/mo) 1998	Adjusted heat savings (CZK /mo)	Electricity consumption (kWh/mo) 1997	Electricity consumption (kWh/mo) 1998	Electricity savings (kWh/mo)	Electricity savings (CZK/mo)	Total savings (CZK/mo)
January	6 803	4 230	135 199	241 150	190 706	50 444	115 642	250 841
February	4 024	3,380	60 838	232 480	174,311	58,169	210 983	271 821
March	3 840	3 384	110 360	215 640	175 964	39 676	149,326	259 686
April	3 613	2 084	12,989	223 310	157,436	65,874	174 320	187 309
Total	18 280	13 078	319 386	912 580	698,417	214,163	650 271	969 657

Conclusion

By upgrading the measurement technology of the hospital complex it was possible to launch an energy savings program and introduce genuine control and management of all kinds of

energy consumption The archived data is used to evaluate the activity of the individual groups of users and appliances The system allows investment in the facility's energy management to be planned more skillfully

Photographic Documentation of the Litoměřice Hospital Project

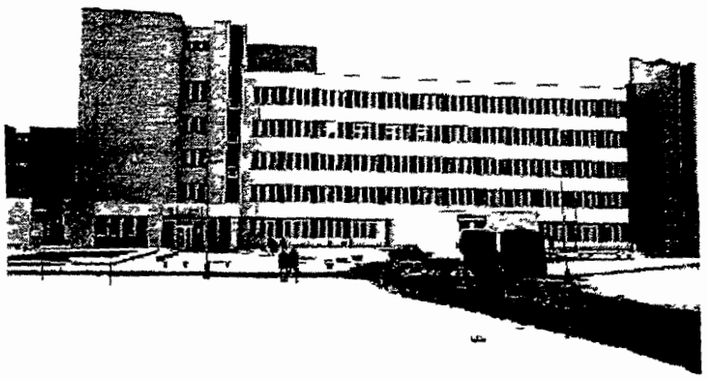


Photo 4 – The main building of the Litoměřice Hospital

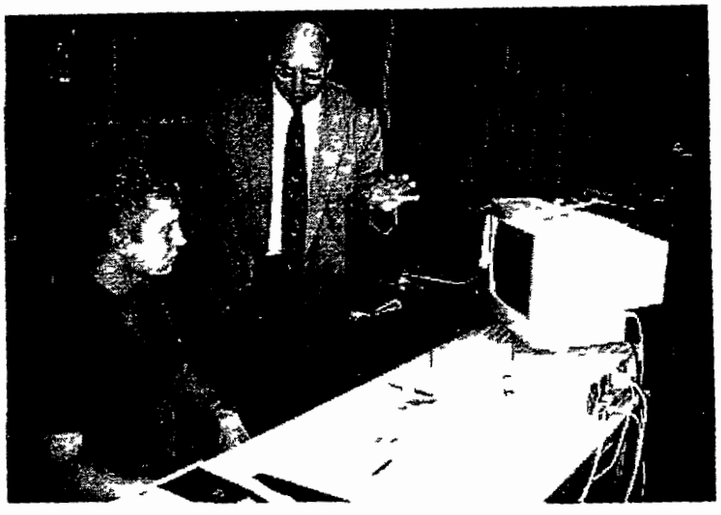


Photo 5 – The dispatcher's center in the Litoměřice Hospital

Appendix 3

Frýdlant Hospital

Address V uvoze 860, 464 15 Frydlant v Čechach, Czech Republic

The Frydlant Hospital is a regional facility At present it has 146 beds and provides medical care in 4 basic areas of medicine

The hospital is supplied with electricity, gas, and heat by TEPLO Frydlant (Frydlant Heat) and with drinking water by the Frydlant Waterworks Company

The energy efficiency project in the Frydlant hospital involved replacement of the back-up source of electricity with a cogeneration unit and a change in the heat supply The cogeneration unit is comprised of a JENBACHER JSM 106 GS-N piston motor with an electrical output of 70 kW and a heat output of 115 kW The power and heat produced in the cogeneration unit are fed to the hospital's power and heat distribution networks Surplus power and heat are supplied to the city's distribution networks

Work Carried Out under the Energy Efficiency Project

- replacement of the back-up power source with a new cogeneration unit and connecting it to the natural gas network
- connecting the electrical unit to the external electricity network
- connecting the hot water network to the cogeneration unit

Sources of Project Funding

The cost of the entire project came to 4 6 mil CZK The funding scheme broke down as follows

- 0 6 mil CZK contribution from US AID
- 1 6 mil CZK grant from the Ministry of Finance
- 2 4 mil CZK from the city's resources

Description of the Work

The inoperative back-up source of electricity in the hospital's engine room was replaced with a cogeneration unit with a gas motor This unit is an "island type" and can serve both as a back-up source and in cooperation with the external distribution network For that reason both networks were interconnected To balance the electricity load curve an Optimier 58 device made by Contes was installed The heat produced by the cogeneration unit is used for heating the largest hospital building (surgery/internal medicine) and preparing hot domestic water for the complex The exchanger station was connected to the hospital's heating system and at the same time connected to the city's district heating system

Schedule of Construction Work

Work was begun in July 1997 and the entire technology was installed and activated in January 1998 Trial operation began that month and was completed in June Standard operation was begun in July

Project Evaluation

It is necessary to assess the entire project at two levels The first level concerns the possibility of self-supplying heat and electricity The second which can be quantified financially, pertains to heat and electricity costs By June 9, 1998, the cogeneration unit had worked 2 660 hours In the first four months it had produced 143,763 kWh of electricity for the complex, representing 97% of hospital consumption, and 43,350 kWh had been sold to the external network The heat produced was used for heating the surgery/internal medicine building and in preparation of hot domestic water Heat was not distributed to the district heating network From the daily gas load curves the three-month period that the cogeneration unit worked at full capacity can be recognized

Table 4 - Assessment of savings in the Frydlant Hospital over four months

	Heat consumption (GJ/mo)	Savings (CZK/mo)	Electricity consumption (kWh/mo)	Supplies to the network (kWh/mo)	Payment with VAT (CZK/mo)	Electricity savings (CZK/mo)	Total savings (CZK/mo)
January	1 132	163 979	46 765	0	106 204	-3 321	23 228
February	1 025	150 391	30 260	13 980	73 125	-15 221	9 128
March	1 154	169 289	38 085	16 014	67 507	6 351	33 760
April	747	109 625	32 762	13 356	60 744	3 052	20 801
Total	4 057	593 284	147 872	43 350	307 580	-9 139	86 917

Conclusion

It is difficult to evaluate the project after only four months of operation The greatest value of the project lies in the interest of the hospital administration and energy management technicians in energy The new devices allow for more detailed information about the electricity and heat load curves A year of operation will be required before energy savings the main measure of project quality, can be more objectively assessed Financial savings are presented in the table and above all result from the improved operation of the facility's energy system Further financial savings can be expected under renegotiated supply contracts Adjustments to the contracts have not been made due to the fact that previous long-term experience with the operation of such sources is lacking

The connection of the new energy source to the city's electricity and hot water network requires

- high reliability from the cogeneration unit
- the verification of the hospital's load curves

- the optimal connection of the new and old distribution lines
- the upgrading of the regulation of the exchanger station,
- the optimizing of the demand-side control within the facility

When the cogeneration unit was being assembled in the Frydlant Hospital, an electric regulator was installed for the quarter-hour power demand maximum With its gradual use the reference power was reduced by half This is resulting in needless contractual costs for the spare capacity
When there are surpluses of electricitv and heat, these are sold at very low purchase prices that do not even cover the fuel costs (The fuel cost for production of energv in a cogeneration unit amounts to 0 65 CZK/kWh while the electricity purchase price is set at 0 62 CZK/kWh Naturally, there are also other costs in addition to fuel)

Further savings in the Frydlant Hospital will occur from the fine-tuning of the facility's electricity demand and from concluding a new contract with the energy supplier The current two-level rate with payment for a measured maximum was set for twice as large a capacity Experience over the past five months has shown that the energy maximum can be kept down to half without presenting a danger to the hospital's operation By altering the contract it will be possible to reduce the annual costs by a further 387,420 CZK This will result in a shortening of the simple payback period to 5 3 years Owing to its inexperience with operating the power maximum regulator and the cogeneration unit, the hospital management is proceeding carefully and is planning a change in its contract with Severočeska energetika, a s (North Bohemia Power) for the fall of 1998

Photographic Documentation of the Frýdlant Hospital Project

Photo 6 – The building of the Frydlant Hospital pediatrics department

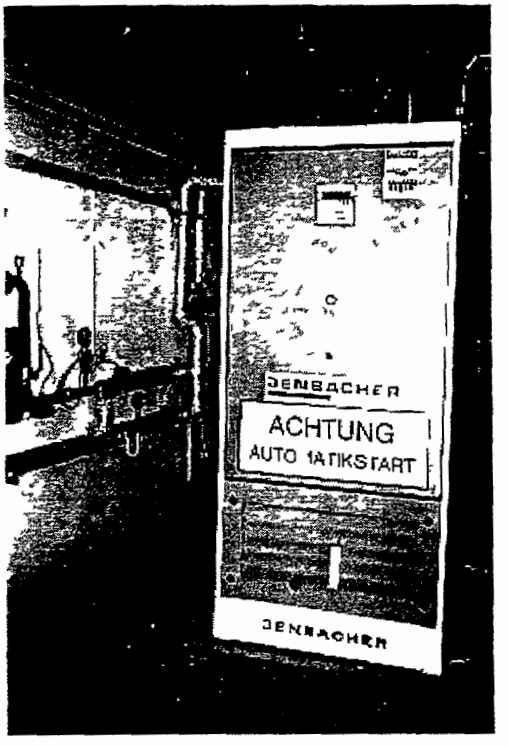


Photo 7 – Front panel of the cogeneration unit installed in the Frydlant Hospital

Appendix 4

Mimoň Ralsko Elementary School in

Address Okružni ulice 471 24 Mimoň, Czech Republic

The Mimoň Ralsko Elementary School was built in 1975 It is comprised of six structures in which there are nine classrooms Several rooms are rented out for commercial purposes (massage, beauty salon, etc) The school's heat and hot domestic water supply is from the secondary distribution system of an exchanger station for a residential area The school's facilities are not used uniformly and so a solution was sought that would permit individual heating according to the instructional schedule

The energy efficiency project in the school involved introducing an Individual Room Control (IRC) regulation system A TRASCO – HELIA 28L system was installed

Work Carried Out under the Energy Efficiency Project

- Mounting of thermometers in individual rooms and connecting them to the control unit
- Replacement of the radiator valves and upgrading of the Heimeier brand regulation heads and connecting them with the control unit
- Installation of the control unit and equipping it with control software
- Adjustment of the ventilation units in the gymnasium, including regulation

Sources of Project Funding

The cost of the entire project came to 1,550,000 CZK The funding scheme broke down as follows

0 6 mil CZK contribution from US AID
0 95 mil CZK from the city's resources

Description of the Work

This project was carried out in two stages In the first, the school atrium was insulated The single-paned glass in the atrium was taken down, a metre-high wall was erected, and double-paned plastic windows were mounted The atrium interior was lined with ceramic facing tiles

In the second stage the IRC was installed As part of project planning the thermal input of the school was verified by calculation It was shown that some parts of the school were overheated Owing to this, before the valves and heads could be mounted, some heating elements had to be removed from the school's atrium The remaining heaters were equipped with a total of 208 HEIMEIER radiator valves with regulation heads In the entire school complex, 126 area thermometers were mounted Regulation heads and area thermometers were connected to 14 TVS 103 control units These units were connected to the control computer

Schedule of Construction Work

Work was begun in July 1997 The entire technology was installed and activated in September and the installed system was operative during the subsequent heating season

Project Evaluation

Over a period of two months adjustments were made to the software so it would optimally meet the school's requirements The invoices for the 1997/98 heating season established savings for heat in comparison with the preceding year of 231 1 GJ/year (5 1%) The new system made it possible to

- operate individual buildings with optimal consumption of heat and increase the thermal comfort in the gymnasium
- reduce the dissipation of specific heat consumption by regulating the heat in various months to a value of 0 64 ± 0 068GJ/^{0}D
- raise the interest of the school in demand-side management
- fairly issue invoices for heat consumption in the space used commercially

Table 5 - Evaluation of the Savings Project in the Mimoň School

Various parameters of specific energy consumption

Period	Heat Consumption (GJ /heating season)	Calculation of degree days	Consumption (GJ/m^2)	Consumption (GJ/t m^3)	Consumption (GJ/^{0}D)	Savings (%)
1995/6	3 077 2	4 067 2	0 82	0 2366	0 76	
1996/7	2 504 3	3 808 1	0 67	0 1926	0 66	13 2
1997/8	2 273 2	3 642 4	0 61	0 1748	0 62	6 1

Heating area of the school	3745 m^2
Heating volume of the school	13004 m^3

School gymnasium represents a heating volume of	950 m^3
Avg temperature in the gymnasium	14 ^{0}C
Number of degree days	2482 ^{0}D

Savings of 13 1% resulted from the insulating of the school atrium prior to the 1996/97 heating season The installation of a heating regulation system throughout the school complex led to a futher 5% reduction in heat consumption in the past season The previously inadequately heated gymnasium consumed about 9% more heat which was covered from savings The overall heat savings come to 14% corresponding to 634GJ

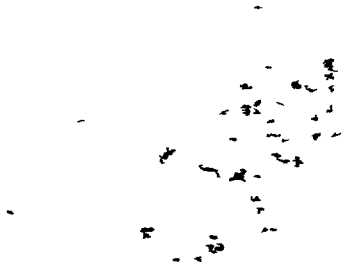
Conclusion

It is necessary to evaluate this project from the standpoint of thermal comfort provided The improvements made to the atrium and the introduction of regulation both represent almost equally large savings

Evaluation of the project for the 1997/98 heating season indicates that in schools with disparate operational use this type of regulation has proven itself

In the gymnasium, which represents about 7% of the heated volume of the entire school, the temperature during instruction was 12 to 14 C This past winter students and staff had the

proper temperature of 19 C Investigation established that this increase of thermal comfort represents an increase in heat consumption of about 9% In the final analysis, the atrium improvement and introduction of regulation together produced savings of 27% representing 1228 GJ/heating season By fine-tuning the program and recalibrating the area thermostats even more savings could be achieved



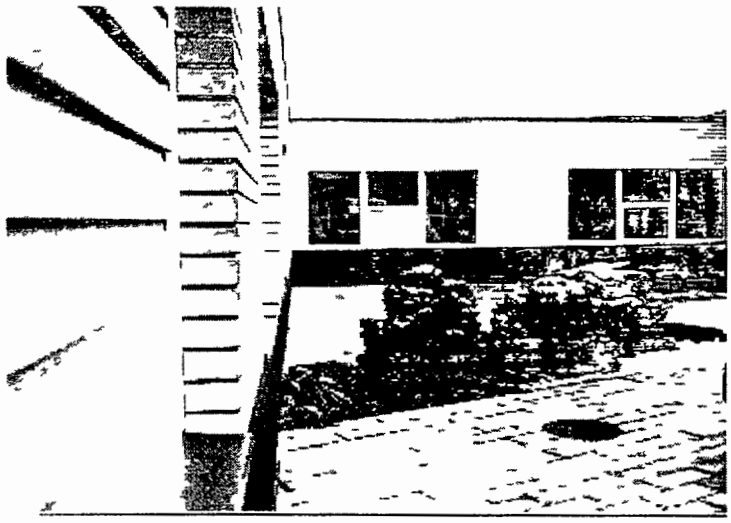


Photo 8 – View of the insulated atrium of the Mimoň Ralsko Elementary School

Photo 9 – Adjustment of an area thermostat